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16. Abstract (MAXIMUM 200 WORDS)

This report describes a process for evaluating the capability of simulators to support performance-based assessment of mariner proficiencies. The step-by-step approach produces an evaluation protocol for examining the following capabilities of a subject simulator: to provide flexible exercise programming to the assessor; to replicate the characteristics of actual equipment; to simulate the operational conditions required to demonstrate the desired performance; and to support thorough debriefing of the assessment candidate. The general method is illustrated with a case study, examining the capability of two PC-based simulators to support the assessment of mariner performance in Automatic Radar Plotting Aid (ARPA) operation. The approach can be generalized to the evaluation of simulators of other marine equipment and of equipment in other industries, and to the evaluation of simulators for training. The method is compliant with the requirements of the International Maritime Organization (IMO) *Seafarers' Training, Certification and Watchkeeping (STCW) Code* and with the best practices of Instructional Systems Development (ISD).

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EXECUTIVE SUMMARY

Introduction

The United States Coast Guard (USCG) has introduced significant changes in the requirements for the training and qualifications of mariners. These changes occur in the context of heightened concern for the safety of navigation, increasingly challenging shipboard conditions, and changing international agreements, all of which have resulted in greater demands on the competence of ships' crews. The new requirements emphasize the practical demonstration and critical assessment of mariner performance to ensure competence for licensing. To provide technical support to the USCG National Maritime Center (NMC) in the implementation of these new requirements, the USCG Research and Development Center (R&DC) investigated some of the central issues in assessment. Project findings provide model processes for the development of rigorous and practical performance-based assessment procedures by industry, and guidelines for the critical review of these procedures by the USCG or third-party reviewers.

Objectives and Technical Approach

The primary objective was to develop an approach for evaluating a simulator's capability to support specific, performance-based assessment procedures. The basic assumption of the approach is that performance-based objectives for the assessment of specific mariner proficiencies should serve as the technical foundation for simulator evaluations. That is, the performance that an assessment candidate must demonstrate, and the conditions required for demonstrating that performance, should provide the basis for specifying the required characteristics of a simulator to support a valid assessment. This report documents a step-by-step method for determining the required simulator characteristics and for preparing a protocol to be used for evaluating a simulator. The approach developed is based on: (1) mariner performance requirements; (2) assessment conditions required for demonstrating performance; and (3) operational requirements for the shipboard equipment used by the mariner. This approach can be applied to simulators of varying capabilities and cost. This will help to identify the most cost-effective simulator for a valid assessment of mariner performance.

To test the approach, an assessment of Automatic Radar Plotting Aid (ARPA) operation was used as a case study. The ARPA operation was chosen because it is one of the proficiencies mandated by the *STCW Code*. STCW-defined mariner performance assessment objectives for ARPA operation were taken as a starting point, and the conditions for their assessment were used as a basis for determining the required simulator characteristics. These requirements were incorporated into a simulator evaluation protocol, which was applied to two commercially-available desktop ARPA simulators.

Conclusions

The project demonstrated the feasibility of the approach to simulator evaluation. The ARPA simulator case study successfully identified important differences in the capabilities of two different desktop simulators to support performance-based assessments. Further, the present evaluation protocol explicitly incorporated standards for simulators established by the IMO *STCW Code*. Thus, the more general simulator evaluation method can be fully consistent with these IMO standards.

The present application of the simulator evaluation method was limited to PC-based ARPA simulators. However, the method is generic and has a broad range of potential applications, such as: more complex ARPA simulators; other bridge and engine room equipment simulators; other maritime simulators (such as vessel traffic system simulators); and simulators used in other industries (e.g., flight simulators, driving simulators, power plant control room simulators). Although the present application focused on the use of simulators for performance assessment, the evaluation of simulators for use in training applications would be similar. Once objectives are established for a training program, simulator evaluation criteria could be developed based on training requirements.

There is a broad range of potential users of the evaluation method. Training institutions (e.g., maritime academies, colleges, and commercial training centers) could use the method for selecting cost-effective simulators to meet their needs. The USCG, other regulatory agencies, or third-party reviewers could adapt the method in developing standardized evaluation procedures for different types of simulators. Simulator manufacturers could use the method to identify the features and capabilities needed in new simulators and in upgrades to existing simulators.

Recommendations

The following actions by the USCG, maritime academies and other training institutions will make the most effective use of the research findings:

- The USCG should make the current methodology widely available to the maritime community and encourage its inclusion in performance-based assessment courses or in “train-the-trainer” courses.
- The simulator evaluation method documented in this report should be applied to a wide range of simulators so as to create a library of simulator evaluation protocols. The USCG should encourage the maritime academies and other appropriate institutions to apply the methodology to other types of simulators, share general lessons learned, model protocols for other types of simulators, and share actual results of these evaluations.
- The USCG should develop, or encourage appropriate institutions to develop, standardized evaluation procedures for various types of simulators. These procedures could include standard scenarios and conditions, as well as guidelines and cut-off scores for accepting or not accepting a simulator or a course based on it.

- The USCG should make the ARPA simulator evaluation protocol widely available and consider requiring its use as a standard evaluation for ARPA simulators used in training courses.